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THE OCCURRENCE OF

MYOPIA

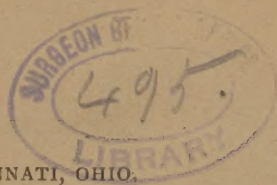
AMONG SCHOOL CHILDREN.

presented by Dr. S. C. Ayres

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WORK ON "HYGIENE OF THE EYES."

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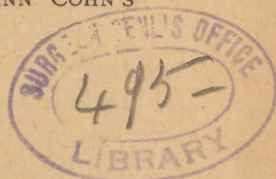
} CINCINNATI, OHIO.



THE OCCURRENCE OF MYOPIA AMONG SCHOOL CHILDREN.

TRANSLATED FROM THE GERMAN OF DR. HERMANN COHN'S
WORK ON "HYGIENE OF THE EYES."

BY DR. S. C. AYRES AND
PROF. J. REMSEN BISHOP, } CINCINNATI.



The influence of school life on the eyes is a question which has excited great interest in the medical and educational world since 1865-66, when Dr. H. Cohn, of Breslau, made his first extensive examinations of school children. He examined over 10,000 scholars in different grades, and then later on followed up the influence of school life, noting the increase of myopia from class to class. His statistics attracted great attention throughout Europe and in this country, and soon the good work which he began was taken up by numerous other men. It enlisted the interest of the most prominent men in the profession, and from that time to the present it has continued, until statistics relating to more than 200,000 scholars in various kinds of schools, colleges, seminaries and gymnasiums have been collected. This gives an idea of the immense amount of work done in this line. Statistics such as these are of great value and are worthy of credence. They teach lessons which may guide us in conducting the education of children, so as to avoid the dangers which necessarily surround them.

The advantages of this work are shown in the better construc-

tion of school houses. Compare the school houses of the present day with one of the old ones constructed say thirty years ago. Here a large percentage of the desks were arranged to suit the space in the room, regardless of the way the light would fall upon the desks of the scholars..

In the old school houses the window panes were very small, so that the cross pieces cut off much of the light so greatly needed in our smoky city. Some of these windows still continue to shed their obstructed light on the children's desks—and this is probably true of other cities.

There has also been a marked improvement in the construction of desks. The little tots no longer dangle their feet in mid-air without being able to touch the floor with even the tops of their toes. Desks now are comfortable and built to suit the various grades of physical development. But the most important result of this extensive investigation of the influence of school life on the eyes has been the general spread of intelligence on this point among laymen. At the present time all intelligent teachers in public and private schools, colleges and seminaries, have more or less information on the influence of school life in developing myopia. In fact the *teachers* often and, perhaps, generally first discover these defects and report them to the parents. This usually leads to an investigation and a correction of the ocular defect.

Children of the present day with optical errors, are able to study with ease and comfort, and more than this their eyes are so protected that they do not suffer from the ocular diseases incident to those optical errors.

Last year Dr. Cohn published a work entitled "Hygiene of the Eyes." There is much in it of interest to the medical man, but also much to the layman. Teachers, professors, parents, guardians, in fact all who are interested in the education of youth, will find in it a fund of information which is of great interest and value.

The book, after a brief description of the anatomy of the eye, discusses the acuteness of vision, errors of refraction, constitutional and acquired diseases which affect vision, and then

opens up the question of myopia, which is considered in a masterly way from any stand point. Statistics are collected from reliable sources and so treated that the influence of school life on the eyes of children is clearly shown. The effects of bad illumination—natural and artificial—the influence of ill-constructed desks, of badly arranged rooms, and many other allied questions.

The translators have given only that portion of the work which relates to the development of myopia among school children.

The exhaustive manner in which the question is handled covers every essential point of inquiry, and the thoroughness of research and the reliability of contributors to the statistics, render them of the greatest value.

"Myopia is a very widely spread disease. Among 40,000 patients that came into my clinic, 6,707 were short-sighted, that is 16.8%. Mooren observed among 108,416 patients 8,452, 7.8%, suffering from myopia.

A far better insight into the extent of myopia than reports from eye-clinics, is given as by researches among school children, and we possess in this regard materials which do not exist in such completeness in the case of any other disease.

Randall found in the examination of 167 reports that of 213-690 persons, examined only for the occurrence of myopia, 17.9% were short-sighted.

The first communications concerning the eyes of school children, so far as I can determine, were made by James Ware, in the year 1812. In a military school at Chelsea among 1,300 children, only three complained of short-sight. On the contrary, of 127 students in Oxford in 1803, there were not less than 32 who made use of lorgnettes or spectacles. "It is possible," adds Ware, "that several were led to the use of glasses by fashion, but their number is surely inconsiderable in comparison with those who really saw better through glasses."

Between 1840 and 1850, as Schurmayer relates, inquiries were made in the schools of the grand duchy of Baden, and

these revealed that of 2,172 pupils of the 15 learned institutions, 392 were short-sighted, that is $\frac{1}{5}$ th of all pupils. Among 930 pupils in the higher Bürgerschulen 46 were found short-sighted, therefore about $\frac{1}{20}$. In the fifth and sixth classes (the highest) of the gymnasiums, 25 to 50% of the pupils were short-sighted.

In the year 1848 Szokalsky instituted inquiries in Paris and learned that in the College Charlemagne 1 in 9 was short-sighted, and in the College Louis le Grand, 1 in 7. This result was the more strange since among the 6,300 pupils in the Parisian elementary schools of the sixth and seventh districts, *not a single short-sighted child was found*. Szokalsky gives tables illustrating the gradual increase of myopia in the several classes. From the fourth to the first, the scale of short-sight rose in the College Charlemagne as 1: 21, 14, 11, 8, 9; in the College Louis le Grand as 1: 11, 12, 7, 4. In the latter case Szokalsky seems himself to have made the examination, still, this is not absolutely certain. Information concerning the degree of myopia is wanting.

In contrast with these older observations, which relate to complaints of children, or inquiries or very uncertain proofs, those published by E. von Jäger in Vienna in 1861, deserve prominence as pioneer works, for this investigation was the first to employ personal observation with the ophthalmoscope to determine the refraction of the children. He found in an orphan asylum among the boys who were 7 to 14 years old, 33% with normal sight, 55% short-sighted and 12% hyperopic (far-sighted). On the other hand, in a private school among pupils from 9 to 16 years of age, 18% normal, 80% short-sighted and 2% hyperopic. Jäger also noted the varying degree of short sight, although this was not arranged according to classes. His material also (100 cases) was, as he himself says, too small for general conclusions.

In the summer of 1865, Rüte himself examined from two Leipsig common schools in which 2,514 pupils were enrolled, 213 children sent to him by their teachers as suffering from affections of the eye. Of these 213, 107 suffered from inflam-

mation of the lids; conjunctiva and cornea, 107; 48 from short-sight. Therefore the number of short-sighted varied between 2% and 3%. Surely a large number of short-sighted pupils did not come within the knowledge of Rüte.

Since in the case of no one of the older inquiries was the number of children sufficient for the exclusion of accidental causes, nor in any case were the children examined by the physician himself; since, also, the degree of myopia in relation to the classes and the school sites and school seats were not taken into consideration, I undertook, in 1865-6, the examination of 10,060 school children, in such a way that first a preliminary examination of all the children was made in the class with letter-tests and then an individual examination with the ophthalmoscope of those who had not seen the letter-tests at the normal distance. Farther, I measured in each of the 166 classes the size of the children and all dimensions of the seats which I chanced to find. I also employed an illuminated chart. In the case of each pupil the age, school-year, reading-test, resulting spectacles and the result of the test with the ophthalmoscope were recorded.

In this manner I examined five village schools in Langenbielau, Kreiss Reichenbach in Schlewig; 20 town elementary schools; 2 intermediate schools; 2 higher girl's schools; 2 Realschulen, and 2 gymnasiums in Breslau, altogether 10,060 pupils, of whom 1,486 were village children and 8,574 city children. Of them I found 52% of the village children and 19.2% of the city *not* emmetropic¹ but ametropic². Altogether 17.1% of all pupils—almost a fifth part—were ametropic. This total would doubtless be considerably larger if I had not at that time excluded all cases of $M. < 1 D^3$ as not of sufficient consequence from my tables.

I found 83% of emmetropia, 13% of errors of refraction

¹Normal.

²Abnormal.

³Means myopia less than one dioptrie. A dioptrie is the unit of measure in cases of refraction, and is one meter in length.

(of this 10% myopia) and 4% of this eye-diseases. The frequency of myopia is shown in the following table:

I noticed in—

	PER CENT. M.
5 Village schools, - - -	1.4
20 Elementary schools, - - -	6.7
2 Higher girl's schools, - - -	7.7
2 Intermediate schools, - - -	10.3
2 Realschulen, - - -	19.7
2 Gymnasiums, - - -	26.2

Therefore among 10,060 children 1,004 M. =9.9%.

- From this follows: 1. *That in the village schools only a few appeared short-sighted; that, on the contrary, in the city schools the number of the short-sighted continually increases from the lowest to the highest school; that, therefore, the number of the short-sighted stands in direct proportion to the longer strain to which the eyes have been subjected.*

In the city elementary schools from four to five times as many short-sighted children were found as in the village schools. In the village schools the number of the short-sighted varies only in general between 0.8% and 3.2%; on the contrary, in the 20 elementary schools, the number was between 1.8% and 15.1%. In the different gymnasiums the difference amounted to only from 2 to 4%.

It appeared: 2. *That the number of the short-sighted from class to class in all schools increased.* On the average, the number of the short-sighted in all third, second and first classes of the village schools was 1.4, 1.5 and 2.6%; in the 20 elementary schools, however, it was 3.5, 9.8 and 9.8%.

In the Realschulen the number of the short-sighted from the sixth to the first grade was: 9, 16.7, 19.2, 25.1, 36.4, 44%; in the gymnasiums, 12.5, 18.2, 23.7, 31, 41.3, 55.8%. Therefore, *more than half of the members of the first grade were short-sighted.*

Naturally there were here and there slight discrepancies, as, for instance, in the first grades as compared with the second grades, but this usually resulted from the fact that generally

in the highest classes, since few children were included, a single case of short-sight gives an altogether different per cent. from similar conditions in the larger lower classes. With larger numbers, however, and on the average, I proved the progression constant.

In the village and elementary schools I found no essential difference between the two sexes; still, the large number of short-sighted which the gymnasiums and Realschulen show, proves that, amongst the 10,060 children, twice as many boys as girls were short-sighted.

Increase of myopia by school years was also shown in connection with the increase by classes. In the village schools I found among children who had passed the first half-year, none as yet, short-sighted. On the contrary, the fifth and sixth school year in the college schools showed 1.6%; in the city elementary schools 8.2%; in the intermediate schools 11.9%; in the Realschulen and gymnasiums 14.5% short-sighted. When I added the first four, and the last six school years (which contained the ages from about 7 to 20) I found 4.5, 9.6 and 28.6% short-sighted.

There was obviously shown in the 166 classes of the 33 schools, *an increase of the degree of myopia from class to class in all schools.* I chose at that time six indices of myopia.

1. M.1—1.5; 2. M.1.75—2.25; 3. M.2.5—3; 4. M.3.25—4; 5. M.5; 6. M.6. The 1,004 short-sighted children were divided under these six indices of myopia as follows: 466, 303, 150, 76, 6, 3. In no village school did I find a higher degree than M.2.25. On the whole, almost half of the short-sighted showed myopia less than 1.5. M.5 and M.6 occurred in gymnasiums and Realschulen. I found the higher degrees of myopia more frequently among the boys than among the girls.

Also with increasing age the degree of myopia increases, although the higher degrees of myopia occur more frequently in the first four school years than in the seventh to tenth year of age.

By adding together the degrees of myopia found in a class

and deducting the total by the number of short-sighted, I obtained the *average degree of myopia of the class*. The mean of these average degrees for the several classes for the school gave the *average degree of myopia of a school*, and the mean of these average degrees found in the several schools of the same class, gave the *average degree of myopia of a class of schools*.

Thus I found the average degree of myopia in five village schools 1.7; in 20 elementary schools 1.8; in two intermediate schools 1.8; in two Realschulen 1.9, and in two gymnasiums 2.0. The average degree of all short-sighted pupils was M. 1.8. *Consequently, the average degree of short-sighted pupils is constantly insreasing from the village schools to the gymnasiums.*

The following statistics show that it also increases from the lowest to the highest classes, from the sixth grade to the first.

In Realschulen: 1.8, 1.9, 1.9, 1.9, 1.9, 2.3.

In gymnasiums; 1.8, 1.9, 1.9, 2. 1, 2.4, 2.4.

The average degree in the two sexes is not very different. Higher degrees than M.6, without complicating eye-diseases, were never observed by me.

The wish which I expressed in the publication of my discoveries in the year 1867, that elsewhere similar researches might be undertaken, has been generally fulfilled. There is a large mass of statistics gathered with much care by capable investigators in other cities, statistics which have the added excellence that in them the degree of M. <1 D has also been taken into consideration. I had neglected these low degrees as practically unimportant; they are, however, important in the study of the development of myopia. Consequently, the discovered per centages of myopia are in the following tables generally much greater than mine.

Further, not both eyes together but each eye separately, has been examined by some of these physicians; other investigators have subjected all children, even the apparently normal, to the mirror test (by ophthalmoscope).

Percentage of Short-Sighted Pupils in the United States, European Statistics are not copied.

YEAR.	OBSERVER.	CITY.	INSTITUTION.	NO.	PR. C'T. M.
1875	Callan.	New York.	Negro Schools..... Primary Department..... Grammar Schools.....	457 ? ?	3 5
1876	Loring and Derby.	New York.	Primary Schools..... District Schools..... Normal School..... Children of Germans..... Children of Americans..... Children of Irish.....	205 249 679	7 12 27 24 20 14
1877	Williams and Ayres.	Cincinnati.	District Schools..... Intermediate Schools..... High Schools.....	690 210 210	10 14 16
1877	Agnew.	New York.	New York College..... Brooklyn Polytechnic..... Academic Department.. Collegeate Department..	579 300 142 158	39 19 10 28
1877	H. Derby.	Boston.	Amherst College..... Howard College.....	1880 122	28 29
1877	Bacon.	Hartford.	District Scholars.....	308	16
1877	Steven.	Hartford.	District Scholars.....	675	18
1881	Risley.	Philadelphia.	Primary Schools— Average age, 8½..... Average age, 11½..... Grammar Schools, age 14... Normal Schools, age 17½....	 228 490 553	 4 9 11 19
1882	Mittendorf & Derby.	New York.	Primary Schools..... Grammar Schools..... Grammar Schools..... College Students.....	203 698 896 201	3 8 13 35
1883	H. Derby.	Massachusetts.	Amburst College.....	254	47
1884	Gardner.	Springfield.	Several Schools.....	1082	9
1885	Randall.	Philadelphia.	Students of Medicine.....	90	10
1887	Tiffany.	Kansas City.	Different Schools.....	2040	5

It would take us too far to describe here the particulars of all of these statistics, which concern almost 200,000 school children. They collectively establish the general results of my researches, and also in method of investigation differ very little from mine. Besides, many of the statistics have only a local interest. However, in order to give a picture of the enormous industry of the investigators in this sphere, and since, also, such a collection might be important in ethnographical research for further investigations and for the comparison in later decades, I have given the preceding tables concerning 200,000 pupils; of these investigations I will make further mention only where new points of view have been discovered. Only American statistics are copied.

Among the labors which offer new bases of observation those of Erismann (1871) are next to be named. He examined in St. Petersburg 4,368 pupils with Snellen's tests at six metres distance, and found 30.2% short-sighted, 26% normal, 43.3% far-sighted and 5% weak-sighted. He correctly conjectures that hyperopia is the normal condition of refraction in the youthful eye and that only the smaller portion of the cases remain far-sighted. The majority become short-sighted after they have passed through the state of normal sight.

As evidence, the following statistics of classes were of service to him:

CLASS.	I.	II.	III.	IV.	V.	VI.	XII.	IX.	X.
Myopia... ..	13.6	15.8	22.4	30.7	38.4	41.3	42	42.8	41.7
Hyperopia.....	67.8	55.6	50.5	41.3	34.7	34.5	32.4	36.2	40
Emmetropic...	18.6	28	26.4	27.3	26.4	24.2	25	21	18.3

Later I was able in the case where atropine was used in the examination of the entire village school, to furnish proof that Erismann's conjecture was correct.

Erismann's tables agree very well with mine. He frequently observed spasm of accommodation when the acuity of vis-

ion was not complete, and severe reddening of the optic nerve was present. Only in 85% did he find $S=1$, or >1 ; in in 6.8% $S<1$ and $>^2/3$, and in 7.6% $S=<^2/3$. Erismann found that acuity of vision diminished in the higher degrees of myopia. He observed, however, that the stronger concave glasses, on account of their diminution of the size of the object, must reduce keenness of vision. Among 1,245 short-sighted pupils, Erismann observed only in 5% no atrophic choroidal variations. On the contrary, in 71% a moderate, and in 24% a high degree of choroidal changes. In the higher classes these changes were more frequent. According to the school years they increased from 14% to 38%. In degrees of myopia more severe than $M=3.0$, he always found staphyloma posticum; in $M.>6.0$ even 70% of serious variations. Erismann observed insufficiencia recti interni in 32% of all short-sighted pupils. Serious insufficiency and comparative outward squint was more frequent in the higher schools and older classes than in the lower schools and classes. Already, in the weakest degrees of myopia 23% of disturbances of muscular equilibrium occurred; the percentage increased with the degree of myopia.

In order to put an end to all objections against the demonstrability of the first statistical conclusions obtained concerning the increase of myopia among school children, it appeared to me a very important duty *to examine for refraction the same* pupils of an institution after the course of a few semesters. Accordingly, in May, 1870, I examined the pupils of the Breslau Frederick gymnasium, and repeated the examination in November, 1871. At the first examination there were found among the 361 children, 174 abnormal, viz: 35% myopic; 7% hyperopic, and 6% with eye diseases. From the seventh grade to the first grade, I found the following increases in the number of the short-sighted: 13, 21, 27, 35, 48, 58, 60%. They showed 12% myopia 0.75 to 1; 47% myopia 1—2.5; 25% myopia 2.5 to 5, and 6% $M>5$. After one and one-half years 103 normal-sighted pupils and 71 myopic had left the school, only 84 formerly observed as normal and 54 ob-

served as short sighted—altogether 138—could again be examined. Of the 84 formerly observed as normal only 70 had remained normal; that is, 14 or 16% had become short-sighted. The degree of myopia existing meanwhile varied from 0.75 to 2D. Of the 54 previously short-sighted, 28 had suffered a decided increase in degree in the one and one-half years. I found in no case a decrease.

Both the lowest and the highest degree of short-sight, added their contribution to progressive myopia, as follows:

MYOPIA.	INCREASED IN—PER CENT.
0.75—1	30
1—1.25	38
1.25—2.5	69
2.5—3.25	100
3.25—5	43
5—10	66

Among 54 examinations, in 28 *i. e.* 52%, myopia was progressive.

The average of the short-sight of all 28 progressively short-sight pupils was, the one and one-half years previously, $M=2$, *now* $M=2.75$; in this short time the average therefore increased $M=0.75$.

Concerning the acuity of vision it is important to note that all pupils formerly found normal and now found short-sighted had preserved complete sharpness of vision. Only in two cases of stationary myopia (among 26) had the sharpness of vision sank from $\frac{2}{3}$ to $\frac{2}{5}$. Among the 28 progressively short-sighted pupils, one and one-half years before $S=1$; in the case of four it had now decreased $\frac{2}{3}$ and $\frac{4}{5}$. Five of the progressively near-sighted had before sharpness of vision $\frac{2}{3}$. In no case had decrease of sharpness of vision supervened. I found staphyloma in the case of 14 who had, from normal sight, become short-sighted; 26 stationary short-sighted pupils had formerly 7 now 14 staphyloma. In 12 cases of stationary myopia no staphyloma occurred. Among the 28 progressively

short-sighted formerly 15 now 22 had staphylomata. There had occurred, therefore, within three semesters, 10% of changes in the posterior portion of the eye.

These results were confirmed by von Reuss, who repeated his investigations in the Leopoldstadt Gymnasium in Vienna, in the years 1874, 1875 and 1876. He had examined with the mirror all short-sighted pupils, and all whose S was <1 ; also he had tested each normal-sighted pupil by means of convex glasses for possible far-sight, and had examined each eye separately. In May, 1872, he found among 409 pupils, 35% normal, 41.8% myopic and 20.5% hyperopic; 2% astigmatic and 7% with eye-diseases. The number of the short-sighted increased from class to class: 28, 41, 49, 48%. Far-sight decreased from class to class: 30, 27, 14, 12%. He found the low degree H <1 in 85%. Among 162 examined with the mirror, von Reuss observed in 41 (25%) decrease of accommodation, namely: 16 in the case of M <1 ; 12 in M 1-1.75; 13 in M 1.75-2.5; 11 in M. 2.5-3; 13 in M 3-6. No increase of this disease showed itself in higher classes. 102 pupils had different degrees of myopia in the two eyes; 54 had one eye normal; 38 had myopia and 16 had hyperopia in the other eye; 7 had a myopic and a hyperopic eye.

One year later the examination was repeated. Only 20 of the children being present. Unfortunately the mirror was not employed. Refraction was found the same in 42%; progressive in 46%; regressive in 12%. In the lower classes more stationary cases were found than in the higher. 71% remained normal; 19% had become short-sighted; 10% had become far-sighted. Of the myopia 28% were stationary; 61% progressive; 11% regressive; showing spasm of the ciliary. Examination with the mirror and atropinization backing these figures, are to be accepted with caution.

Finally, von Reuss' third examination took place in 1875, in the class of 201 pupils.

TOTAL PR. CT. AFTER 1 YR.	PR. CT. AFTER 2 YRS.	PR. CT. AFTER 3 YRS.
Stationary, 42	37	28
Progressive, 47	50	61
Regressive, 10	11	10

	ALSO STATIONARY.	PROGRESSIVE.	REGRESSIVE.
From 1872-'75 Emmetropic, 56		37	10
Myopic, 15		77	8
Hyperopic, 12		72	16

For particulars concerning increase of each degree of each affection, see the original essay. Only 12% of the short-sight remained *unchanged* after three years. Spasm of accommodation was observed but regression was never found in the case of $M > 3$. By comparison of results obtained through sight-tests and the mirror, von Reuss found, 1. *Apparently*, progression is brought about by spasm of the ciliary in a not very large number of eyes. Spasm of the ciliary can exist several years without affecting the structure of the eye. Spasm of the ciliary changes the real refractive condition in the direction of progression; this is the most frequent result. 3. Progressive changes come without accompanying disease of accommodation; this result is by no means rare. Therefore, the origin of myopia or its increase, does *not always* depend upon spasm of the ciliary muscle. On the contrary, Burchardt, in Berlin, was led by determinations of the near-point to the conclusion that disease of accommodation has *always* been present a long time, and is, almost without exception, the cause of definite short-sight.

Worthy of recognition as the careful mirror-examination by most late investigators of the refractive condition of all pupils is, it is still by no means infallible. I have often enough observed that accommodation is *not* relieved of strain with plane mirror and in large rooms—indeed, that it is in some cases strained even there; this is also admitted by von Reuss and Stellwag. Further, not a few cases are known to me in which experienced colleagues, who are very proud of their determinations of refraction with the erect image, have erred by 1—2 D, especially in the case of weak myopic and hyperopic subjects. The total measure of the accommodation muscle is, indeed, not always quite certain. Therefore, statistics founded upon observations of this kind, are not ab-

solutely certain; to this end all children and, if possible, the observer himself must be atropinized. *Homotropine* in weak solutions acts upon the accommodation too ineffectually to make us lay any real weight upon measurements by this means. Durr, in 1883, examined with *homotropine*, the pupils of a lyceum, but only 318 of 538 underwent the administration of the mydriatic. Naturally, Durr found diseases of accommodation frequent in all conditions of refraction. For questions of hygienic statistics reading-tests and spectacle-tests will, in the case of school children retain their great value.

Also, Conrad very carefully examined the school children in a body with the ophthalmoscope and with spectacles, and is of the opinion that with the mirror one is never sure that accommodation is fully relaxed. He, however, considers that differences when atropinization was used are "extremely small." He found among 3,036 eyes, by reading tests: hyperopia 11%; emmetropia 55%; myopia 32%; by mirror, hyperopia 47%; emmetropia 29%; myopia 22%. For the rest he agrees with Erismann, that hyperopia slowly passes through normal sight into short-sight. With the mirror he found in the lowest classes 70% hyperopia; in the highest only 22%, emmetropia in the lowest classes 25%, in the highest and in the middle classes 30 to 35%; also, myopia rose from 4 to 51% by mirror-test, from 11 to 62% by the reading test, so that there was about 10% of spasm of accommodation present.

Repeated tests of the same pupils are found in the late work of Ott, in Lucerne; of Netoliczka, in Graz; of Florschütz, in Coburg; of Erismann, in St. Petersburg; of Reich, in Tiflis; of Derby, in New York; of Albrecht, in Strassburg; of Adamük, in Kasan, 1877 to 1886; of Haab, in Zürich, 1882 to 1888; in the Russian cadet-corps, 1882 to 1887; of von Hippel, in Giessen, 1881 to 1889, and of Schmidt-Rimpler, 1885 to 1889.

The communications of Florschütz show results of the highest interest, since they show the decrease of the number of short-sighted pupils in the newly constructed "school palaces."

Thus, the common schools showed still in 1874 12 and 14, in the year 1877 only 4 and 7% myopic; 2323 pupils examined in 1874 showed 21%; in 1877 only 15% myopic. Erismann found in 1876, in the case of 350 eyes which he had examined in 1870, 67% increase of short-sight, of which 16% was change from emmetropia to myopia, and 25% increase of myopia. Reich saw in six years 14% change from hyperopia to myopia; 44% from emmetropia to myopia, and 81% increase in myopia.

H. Derby examined 254 students of Amherst College (19 to 23 years of age) again four years after entrance into the institution, and found instead of 15% hyperopic, 49% emmetropic and 35% myopic, which had been recorded on entrance; 18% hyperopic. 34% emmetropic and 47% myopic.

Of the 125 normal-sighted 23% had become myopic; the degree was on the average 1D. This fact is of the greatest importance, because widespread opinion since the time of Donders, holds that after the age of 15 myopia does not often develop in eyes hitherto sound, and that after the age of 20, it never develops in sound eyes. From my own practice I can produce many observations similar to those of Derby.

Derby shows that of 90 short-sighted students, 32 kept their degree of myopia; 28 suffered an increase of 1—2.5 D during their four years course. The average degree at entrance was 1.8 D; at graduation 2.4 D; an average increase, therefore, of 0.6 D.

Ulrich had charge of 273 eyes which Hoffmann had examined three years before. He showed in 44% increase in refraction, M1 to >2D. Adamük maintained in 1886 that previous observers had not made repeated examinations of the eyes of the same pupils. From the foregoing it is seen that he was not acquainted with the literature of the subject. He himself examined two gymnasiums yearly for nine years. At first, of 317 pupils 14% were myopic, who in 91% showed increase of short-sight; also 52% hyperopic and 32% emmetropic suffered a change in their refraction.

Haab in Zürich continued yearly till 1888 the examinations begun by Horner in 1882.

Of the 309 pupils then examined, 208 were still in the school after 6 years; at first 16% were ametropic and 3% myopic; after 6 years 25% were ametropic and 11% myopic. The short-sighted had increased fourfold.

The examinations conducted from 1882 to 1887 in the Russian cadet corps, on an average 1896 pupils yearly showed in these 6 years: 24, 24, 24, 30, 23, 23% myopia, an average of 25%. In these observations, however, the lowest degrees were considered, 32% <1D; deducting these, only 17% myopic remain, which come near my results in the *Realschulen*. While the gymnasiums show more short-sighted pupils, still, 39% of the myopic pupils in the corps had become short-sighted therein. In the fourth and fifth years of residence 25%; in the third 18; in the sixth 17; in the second 13; in the first 8, and in the seventh 6% of the cadets; most, therefore, in the third to the fifth year.

The observation is also interesting that among the officers found myopic in the military schools, only 35% were prepared in the cadet-corps, while 65% were prepared in other institutions.

Schmidt-Rimpler found among 178 pupils of the Rheinisch gymnasium, after three and one-half years, 18% myopic, who had formerly been emmetropic, and 52% increase of myopia.

Finally, the repeated examinations by von Hippel of 833 eyes in the Giessen gymnasiums must be noticed. 508 were originally emmetropic and hypermetropic; 75 of them—that is 12%—became myopic; among 186 myopic pupils, in 107 cases, 58% increase of myopia was observed.

Of universal interest aught the fact to be that the only examination which has hitherto been made in a kindergarten, and made very carefully, indeed by Koppe in Dorpat, showed *not a single case of myopia*; but on the contrary, 98 per cent. hyperopic and 2 per cent. emmetropic.

MYOPIA AMONG STUDENTS.

In Tübingen Gärtner observed among 138 students of the Evangelical Theological School, from 1861 to 1865: 81 per cent. myopic, and from 1861 to 1879, in the case of a second assemblage of Evangelical Theological candidates 79 per cent. From 1861 to 1882, among 713, he found 78 per cent. myopic.

Donders had already spoken these impressive words: "It would be of the greatest importance to possess accurate statistical data concerning ametropia obtaining among a certain class of men—for instance, the body of students of a university—in order to be able to compare them with results of repeated examinations at a later time:" If in this way it should be found—and I hardly doubt that this, in fact, would be the result—that myopia is progressive in the established orders of society, this would be a symptom worthy of consideration, and means would have to be thought of to stop this progress.

I sought such statistics in 1867, but it was difficult to collect the Breslau students for an examination. Of the 964 students only 410 appeared. Among these 60 per cent. were myopic, namely: Catholic theological students, 53; law students, 55; medical students, 56; Evangelical theological students, 67, and philosophical students, 68 per cent.

In 1880 I examined 108 students of medicine, and found 57 per cent. myopic; before the examination for their degree, 52 per cent.; after this examination, 64 per cent. I long ago entered in my case-book "Examination Myopia," because I observed the beginning and increase of myopia after all hard State examinations, both final examinations in the gymnasiums and seminary examinations, in the case of medical, legal, philosophical and theological examinations.

Derby's results in Amherst College have been given. Seggel remarked among 284 going from the gymnasium as volunteer soldiers and as candidates for officers' positions, 58 per cent. myopic. Collard examined the students in Utrecht in the winter of 1880. 410 of the 550 students presented them-

selves. Among the 820 eyes of these students 27 per cent. were myopic, thus: among theological, 23; medical, 26; law, 29; natural history, 32; pharmaceutical, 31; philosophical, 42 per cent.

Collard did not find more short-sighted students among the older pupils (in years, than among the younger; on the contrary, he found a decrease in number, thus: from 18 to 20 years of age, 30 per cent.; from 21 to 23 years of age, 28 per cent.; from 24 to 27 years of age, 27 per cent. myopic. The oldest pupils are not by any means the most diligent. Donders accompanies the statistics of Collard with remarks. He states that myopia is less frequent in Holland than elsewhere, and that higher degrees of the disease are seldom found. Examination of students and young peasants would be more conclusive than that of school children. Only by repeated examination of these should I decide whether myopia is prevalent or not. Among 354 students in Copenhagen, who belonged to the military schools, Tscherning found 38 per cent. myopic. Among 330 students in Gröningen, Kremer found 32 per cent. myopic; of medical students, only 25 per cent.; of theological students, 57 per cent. Davidson reports from Aberdeen that at the University there at the utmost 12 to 16 per cent. of myopia occur.

Randall found among 92 students in Philadelphia, 10 per cent. myopic. According to the ophthalmoscope only 19 eyes among 142 were myopic, while there was manifest myopia in 54. The fundus oculorum of the short-sighted was in every case abnormal. "The intraocular disturbances," says Randall, "come from straining work, and produce the typical student's eye-ground, to which certain German professors ought to direct the attention of their pupils.

Cranicean tested in five semesters 1885 to 1888, the 229 medical students in Budaspeth, who came to the course on the ophthalmoscope, and found 30 per cent. myopic. Myopic eyes were shown as follows: Up to 1.5 D: 56 per cent.; to 3 D: 27; to 6 D: 46, and to >6 D: 10 per cent. Manolescu found in the Bukarest University 33 per cent. myopic.

MYOPIA AMONG SCHOOL CHILDREN IN DIFFERENT NATIONS.

It has frequently been asserted that the *German* schools are really the hot-beds of myopia. At any rate the researches of Hoffman, Ulrich and Stilling, reveal that among native old Alsations certainly less myopia occurs than among immigrant Germans. Thus, Stilling found in the *Real gymnasium* of St. John, in Strassburg, of which three-fifths were Alsations, among 422 pupils, only 49 myopic=11 per cent; on the contrary, in the *Lyceum*, which contained only one-third Alsations, he found 31 per cent. myopic. Of 100 German pupils in the Strassburg schools, 34 per cent. were found short sighted; of 322 Alsations, only 5 per cent. were myopic. Stilling attributes the great difference to differences in the structure of the orbit.

Pflüger found by examination of 529 Swiss teachers, aged from 20 to 25 years, that the *German* show more short sight than the French. 154 French Swiss had 14.3 per cent.; 357 German Swiss, 24.3 per cent myopic.

	WELSH SWISS, PER CENT.	GERMAN SWISS, PER CENT.	TOGETHER, PER CENT.
M<2.25	4.5	12.0	10.5
M>2.25 and 3.25	59.0	40.	44.0
M>3.25 and <5	27.5	35.5	32.0
M>5 and <6	9.0	10.0	10.0
M>6	0.0	4.5	3.5

Emmert made tests in four Swiss Watchmakers' schools and observed 71 per cent. hypermetropic; 15 per cent. emmetropic and 14 per cent. myopic. Especially frequent there was insufficiency of the internal recti, 54 per cent.; also in the schools of those places in which watchmaking was pursued, 22 per cent. of insufficiency was found, as against 4 per cent. in other towns. Emmert believes that watchmaking, on account of the use of one eye with the magnifying glass, very easily gives occasion for disturbances of the muscles, and that the tendency to this is very easily inherited.

According to Maklakoff, the percentage of myopia among the Georgians and Armenians in the Caucasus, must be very small. Reich asserts the exact opposite, who also considers as very questionable the opinion of Dor: "The farther south you go the more normal eyes you find," and he suggests that Mannhardt especially comments on the national tendency of the Italians towards myopia. In four towns of Tiflis, examined by him, *Reich* found among the Georgians and Armenians more short-sighted than among the Russians. For example, in the gymnasium, 38 per cent. of Armenians; 45 per cent. of Georgians, and 30 per cent. of Russians; also, he observed among the former a higher degree of myopia and a more rapid increase of percentage of myopia with the classes. He was struck with the large, almost prominent eyes of the Armenians and Georgians. The Armenians, also, had more myopia among them than the Grutinians. In the lowest classes of the gymnasium in Tiflis, Reich found only 12; in the highest, 71 per cent. myopic. Moreover, $S=9\%$ in 52 per cent. of the pupils. The wide occurrence of myopia in Russian educational institutions has been shown by Erismann and other observers. The Ural gymnasium, examined by Dobrowsky, forms an exception. This contains mostly Cosack children, and showed only 12 per cent myopic. Not 77 per cent. myopic are reported in the gymnasium of Irkutsk.

Up to this time only a few researches have been made in England.

Priestly Smith found in 1880, among 1,636 school children, 5 per cent. short-sighted, and among 537 seminary students, 20 per cent. myopic. In 1883 Hadlow found, in the schools at Greenwich Hospital, which are reserved for preparation for naval service, among 1,074 pupils who, at their entrance into the institution at the age of 13, had possessed normal sight, after two and one-half years, at the end of their course, 60 pupils affected with myopia, complicated with such disturbances of vision that they had to be rejected as unserviceable in naval employment. Therefore, in two and one-half years

5 $\frac{1}{2}$ per cent. had become so short-sighted that their special preparation for naval service had become useless. Ellis observed in 1885, in the primary schools at Oxford and Hamilton, 24 i. e., 11 per cent. myopic. Frost, in London, observed 11 per cent. short-sighted.

In France, in 1874, investigations were instituted by *Gayat* in Lyons, and included children picked out "on hand or seen au demande du Maitre, in this fashion: a pres de 600" were examined. The number of short-sighted pupils being thus determined, it is not fair to accept this 3 per cent. myopic as representing the per centage of the total number of pupils. Dor, at first, referring to *Gayat's* statistics, concluded that there was far less myopia in France than in Germany. Later, he himself in Lyons, in a lyceum, examined the pupils, and found them 23.4 per cent. myopic (the same as in German gymnasiums).

Nicati in Marseilles, examined 3,434 pupils with glasses and the mirror, and found in the Jewish primary schools, 15 and 10 per cent. myopic, as against 8 and 7 per cent. in the Christian primary schools. Nicati offers this as the best evidence for inheritance, since the Jewish pupils are children and descendants of store-keepers, and the Christian children are descendants of hand-workers, craftsmen and peasants, and in their families from the first generation enjoying school-training. Weiss, in his investigations in Mannheim, was unable to find this excess of myopia among the Jews. Myopia was very frequent among Jews and Christians; still, Weiss found in the gymnasium of that city less myopia (30 per cent.) than in Heidelberg (35 per cent.); he thinks the inheritance of myopia less in the trade and manufacturing towns of Mannheim than in Heidelberg, inherited by the rich class of learned and office-holding people. Also, *Kuchner* in 1889, was unable to find any important differences between Jewish and Christian pupils in the Berlin gymnasiums. Of 367 Jews, 26 per cent.; of 1,023 Teutons, 35 per cent. were myopic; but *Kirchner* observed $M > 8D$ more frequent among young Jews than among Teutons. $M > 4D$ more frequent among Jews than among

those who were not Jews. He thinks that the reason for this must be sought in the earlier bodily and spiritual development of the Orientals.

In Italy, at the instance of Simi, in 1884, by Del Carlo, in Lucca, by Scellingo, in Rome, by Masini in Siena, by Magne, in Naples, by Brignoni, in Trapani, and by Saltini, in Parma, investigations were undertaken which show a very close correspondence in results with those obtained in German institutions.

Also results obtained in Sweden and Hungary resemble those obtained in Germany.

In Roumania, Manolescu observed in Roumania elementary schools, among lower and higher gymnasium pupils, 2, 4 and 16 per cent. myopia; on the contrary, among pupils not Roumanians he found 15, 11 and 21 per cent. short-sighted.

In America, Callan examined 457 negro children. They were from 5 to 19 years of age, and attended two New York schools. Only 2,6 per cent. were myopic; in the higher school 3.4 per cent.; in the lower 1.2 per cent. The short-sighted were, as a rule, over ten years old. The higher degrees M₅ to 10 occurred among pupils over 14 years of age. In the primary departments of both schools there were no short-sighted children; in the higher classes of the primary departments, 8.2 per cent, and in the lower schools, 1.6 per cent. With glass tests Callan found only 67 per cent. of hypermetropia. After he had atropinized himself (truly as valuable for the examination as uncomfortable for the examiners) he found, by the mirror, 90 per cent. hypermetropia. In the Indian schools at Carlisle, Fox observes only 2 per cent. of myopic pupils. In like manner Loring and Derby made researches in New York among 2,265 eyes of school children, and found the same increase of myopia as has been found in Germany, according to classes. It is interesting to note that among children of German parents they observed 24 per cent.; among children of American parents only 20 per cent., and among Irish children, only 15 per cent. myopia. On the whole the number of short-sighted children was less than in Germany; in the primary

schools 7; in the district schools 12, and in the normal schools 27 per cent. myopic. An examination with glasses and mirror which Agnew had made, through a number of physicians, of 1,479 pupils in different higher and lower schools in New York, Cincinnati and Brooklyn, showed in Cincinnati in the common schools 10; in the intermediate schools 14, and in the normal 16 per cent. The result in New York was: In the lowest class, 29 per cent.; in the freshman class 40; in the sophomore class 35; in the junior 53, and in the senior 37 per cent. of myopia. In Brooklyn there were found: In the academic department, 10 per cent., and in the collegiate department 28 per cent. myopia.

Haskert Derby found in Amherst college, 28 per cent.; in Harvard college 29 per cent. myopic. After a year, half of the short-sighted had reached a higher degree of myopia. After 4 years he repeated the examination and found that 10 per cent. of emmetropia had changed into myopia, and that myopia had increased 21 per cent. In 1875 he found: Emmetropia, 51 per cent.; hypermetropia, 5 per cent.; myopia, 45 per cent. In 1879 he observed: Emmetropia, 36 per cent.; hypermetropia, 13 per cent., and myopia 51 per cent.

It is thus seen that American pupils approach very near to the German in myopia; at any rate Randall found in Philadelphia, among 92 medical students, conspicuously, only 10 per cent., while Risley, in the normal school of Philadelphia, over 19 per cent. myopia.

In Buenos Ayres, among 6,163 children, only 4 per cent. were found myopic by Roberts.

Collard, among 790 eyes of Dutch students, observed only 27 per cent. myopia; but among 30 eyes of German students at Utrecht, he found 40 per cent. myopic.

From Oriental schools we have few reports. In a Greek school in Smyrna, Issegonis found 46 per cent. myopic in higher classes.

Upon a visit to Constantinople in 1877, I had access to three Turkish schools, a high school, a military school and a people's school, in which no teacher or pupil wore glasses. In the

military school, General von der Goltz-Pasha examined 379 pupils with my table, and found 17 per cent. *ametropic*, exactly as great a proportion as was found, on the average, among the 10,060 school children of Breslau, in 1865. Among 67 Jemenlis (South Arabians) and Tripolitans, who are recognized as short-sighted, there were 40 per cent. *ametropic*. We do not know how many of them were short-sighted, since no tests with glasses were made.

From all the figures given above it only follows with certainty *that in the whole civilized world, in all nations, the number of the short-sighted increases with the demands which their school work makes, and from class to class.*

THE MYOPIA OF SCHOOL CHILDREN NOT AN UNIMPORTANT DISEASE.

The continued confirmation of the wide occurrence of myopia among school children and the increase of short-sight from class to class have, since, 1865, engaged the attention of all physicians, teachers and officers, and a series of hygienic suggestions for the prevention of school-myopia has been called forth. For several years, however, the voices of well-known physicians have been loud in proclaiming that too much is being made of myopia; that it is not a disease at all.

The first who, in a mild fashion, took opposing ground was Donders himself, whose opinions set forth in 1881, very considerably retreat from his outspoken position in 1864. The same Donders had said: "I say without hesitation that a short-sighted eye is a diseased eye," and we had considered each case of progressive myopia as a case of *actual disease*. The same Donders, who remarks on the preface to the German edition of his works (1866): "For a series of years I have made incisive examinations of the anomalies of refraction and accommodation of the eye, and have determined and tested all the circumstances relative thereto in the case of thousands of eyes;" the same Donders who says at the close of this preface: "Practice joined with learning has here reached the

unusual and glorious consummation of being able to give some prescriptions grounded on ascertained principles, and of being led by a clear insight into the nature of its treatment;" the same Donders declared in 1881, that the injurious consequences of myopia had been much exaggerated. "If the highest degrees are worthy of attention, still they are usually to be corrected by timely use of suitable glasses, and the lesser degrees bring with them a capacity for fine hand-work and learned investigations, which we could not willingly miss.

"In truth," says Donders," with the same emphasis with which he asserted the contrary seventeen years earlier, "if it lay in my power to exclude all short-sight from the world, I should not want to do so. In myopia we see an example of this in certain directions desirable adaptation of an organ to the influence of its use. In use lies immediately a correction for far-sight, which occasions only discomfort and not pleasure. The question is whether in contending with myopia we cannot over-shoot the mark. It would not be at all unsuspected by me, if in the end, the learned and the peasant class have each the most efficient eye for its purposes."

Hitherto no testimony has been adduced that increase of myopia can be stopped by timely provided glasses. I can produce from my case-books many cases to the contrary, in which near work, in spite of glasses early provided, occasioned increase of myopia.

Furthermore, the advantage which several thousands of men who pursue "learned occupations, and (to my mind very superfluous) fine trades," derive therefrom, that they need no convex glasses in old age for close work, entirely disappears when weighed against the suffering which millions of short-sighted men suffer if they have not their distance-glasses, and when weighed against the dangers of progressive short-sight. Donders here forgets that in the case of increasing myopia sharpness of vision is lost and that, therefore, no distance glass restores for distant vision normal sight to the highest degrees of myopia. The man possessing normalsight who wishes to pursue "learned occupations and fine trades," can see these

fine manufactures with ease by means of convex glasses, and still preserve his good vision for distance. For the sake of the comfort of a few thousands of workers in delicate manufactures, and of natural philosophers, to wish that short-sight may not be excluded from the world, is a thought not to be seriously considered.

Also, the view of Donders that myopia is a wholesome correction for hypermetropia, *which occasions only pain and no pleasure*, is only a sounding phrase. It is not a question of pain, but of danger. Hypermetropia brings no danger, myopia occasions it often. The far-sighted man becomes normal through a convex glass, and his eye in the interior suffers no injury; the short-sighted man, in spite of a glass, suffers internal changes of the eye. It is necessary, therefore, to test these remarks of the changing Donders on the subject as of slight value.

On the other side, Donders set forth anew in 1881, that "myopia of a high degree is not only an inconvenience but also a danger to the eye," and that, if it is true that myopia is spreading, we have every reason to check it. In Holland myopia is of less frequent occurrence than elsewhere and, of higher degree is seldom encountered there. For this reason few statistical examinations have been made there. Little good is to be expected from further tests of school children. It is of more importance to examine young people of different classes during the period in which the degree of myopia becomes stationary for life; that is to say, students on the one hand, and on the other young people from the peasant class. If, after a period of years, such examination was repeated, it would be possible to decide whether myopia is spreading.

Also *Otto Becker*, in 1883, held that the view that myopia is increasing now as compared with the past, has not been established. Twenty years ago myopia was not distinguished from hypermetropia. It will be necessary, particularly to gather perfectly accurate results among those bound to military service, and repeat them for 25 years, in order to find out whether an increase is taking place.

Donder's wish was answered by Tscherning in Copenhagen; in the year 1883 his work appeared, which treats of observations upon 7,564 persons from 18 to 25 years of age (not only school children, but also men in military service of all ranks). He examined only with the eye-mirror, and did not in the first year take into consideration his own M of 0.5D. Besides, he introduced an entirely arbitrary classification, in which he reckoned every $M < 2D$ and every $H < 2D$ as emmetropic, which is entirely false. He who needs correction for $-$ or $+1.5$ is just as abnormal as he who needs $-$ or $+2D$.

Although, therefore, he reckoned many as normal-sighted who were not so, yet he comes to the conclusion that the influence of close work is plain. Among students he found 32 per cent.; among clerks, 16 per cent., among hand-workers, who do only average work, only 5 per cent., and among country folks, only 2 per cent. myopic. He holds close work to be a cause of myopia, but considers this, when it remains within narrow bounds (3D), as unimportant. The higher degrees were rare in the schools. The last conclusion is nothing new. I, also, 26 years ago, found among 10,000 children, 919 with M_1-3 ; 76 with $M_{3.5}$, and only 9 with M_5-6 , *but not a single case of myopia greater than 6.*

When Tscherning now finds the highest degrees M_9-12 more frequent among country people, and considers that these higher degrees are congenital and follow altogether different laws; this also is nothing new. Already in the beginning of this century cases of severely myopic country people were discovered; but this does not at all invalidate the laws concerning the increase in the number and severity of cases of myopia in schools. Tscherning observed the people only at the age of 20 to 22; what the condition will be in their fortieth year he naturally cannot know. When he states that the dangerous diseases accompanying myopia concern only $M > 9D$, he errs. I have observed detachment or defects of the retina in the case of M_5 or 6, and every oculist knows that disturbance of vitreous humor, injurious muscle insufficiency, and inflammation of choroid occur frequently in the lower degrees.

M6 is in itself a very uncomfortable condition for life. Moreover, I found among 7,523 persons whom Tscherning examined, only 2.9 per cent. $M > 6$, in whose case close work was the occupation, and only 1.6 per cent. $M > 6$ who did no close work. Therefore, then, it has been shown why we should decide that though admixture of school-myopia with pernicious myopia the former has been really over-estimated.

Tscherning conceives school-myopia as *an anomaly caused by work, produced through adaptation of the eye to work*; not, however, as a real disease. Where has he given proof that out of the so-called weak work-myopia the higher degrees do not afterwards develop? When Tscherning considers myopia up to 9D as unimportant for the future, because among his patients he has seen no case of complete or partial blindness, we can only wish for him, as Donders did for E. von Jäger, in 1866, a long life and a wider sphere of work, that he may be able to examine his 20 years old myopic subjects in the fortieth and fiftieth year of their life. Just then, as Horner has shown the bad forms of short-sight, in the case of previously light degrees, develop themselves. The setting of the limit at 9D is entirely arbitrary with Tscherning. M6 is considered by the military authorities as the least for admittance.

Vessely, in Vienna, in like manner as Tscherning, found among 1,405 military servants at the age of 20 to 24 years, that 35 per cent. had $M < 3$; 39 per cent. had $M 3-6$, and 26 per cent. had $M 7$. The educated divided themselves into three groupes, 21 per cent., 24 per cent., and 10 per cent.; the uneducated into 13 per cent., 15 per cent., and 17 per cent. Therefore, myopia was far more wide-spread among the educated, but only in moderate degree; the high grades were more numerous among the uneducated.

Also, Stilling considers myopia of moderate degree as unimportant; but he is too keen a student of Darwin to dispose of this myopia in Tscherning's manner. Indeed, he holds the view that myopia as a phenomenon of adaptation, is a misunderstanding of Darwin's teaching. Too short a time since the diffusion of close-work has elapsed for an adaptation in

Darwin's sense. He thinks it must be compared with analogous incidents, such as the so-called "ride-leg," or the "hands of the piano-player." One may dispute with Stilling whether the moderate degrees of short-sight are an evil, or, if they are, whether "this work-myopia, compared with the great number of greater ills, is small and very tolerable, and not at all of a nature to rouse serious fears? Truly, we answer, cancer, diphtheria and cholera are far more dangerous than myopia; but, is loss of distance sight a matter of indifference because there are worse ills? Every normal-sighted person who, for one day should wear constantly glasses $+3D$, and thus artificially make himself so short-sighted that he could see clearly only one-third of a metre, would be of a very different opinion. I will not comment upon the bad state of the short-sighted *soldier, rider, hunter, sailor, etc.*, whose glasses have been lost, broken, bent or only tarnished. Concerning the diseases of sharpness of vision, even in the case of slightly myopic persons, something more searching will be said below.

Also, von Hippel attached himself to Tscherning. When he found in a gymnasium of good hygienic condition in Giesen, 34 per cent. of myopia, he wrote the monstrous sentence: "Education and knowledge are not by any care now to be acquired without a certain injury to the body." In 1889, in spite of my rebuke of this sentence, he held it to be "fully and entirely correct," and added that, in spite of the knowledge that reading and writing among youths has a disadvantageous effect upon their eyes, we are compelled to keep them at their studies. I argued to the contrary:

1. If, in truth, education and knowledge are not to be acquired without a certain injury to the body, then must *all* school children, who collectively are busied with reading and writing, become short-sighted, while myopia attacks only, on an average, 20 per cent. of all pupils.

If von Hippel's assertions were correct, we ought also to be able to apply it to other bodily functions of the children. How is it in this regard with the influence of education and knowl-

edge in music? Has anyone yet heard that the hearing of a child had suffered through musical practice? Surely it would suffer if we sounded loud notes for many hours close by the ears. Or shall we, perhaps, find that, if a child is occupied with the acquisition of education and knowledge, the brain suffers injury? Of course, this would suffer if it should be over-worked from morning till night. In its generality the assertion of von Hippel is, therefore, untenable.

2. I contend also that reading and writing *in themselves*, do not produce myopia. Only reading and writing in poor light and in improper positions, and the excessive, hour-long, one-after-another recurring reading and writing produce and favor myopia. Proof: the average very infrequent occurrence of myopia in elementary schools (in five village schools I found 1 per cent.; in twenty public schools 7 per cent. of myopia on the average) who yet write and read as much as the pupils of the gymnasiums. Farther, the increase of myopia in dark public schools (8 to 15 per cent., as against 2 and 7 per cent in light localities).

Also, Kirchner, in his otherwise excellent late work, holds that the acquiring of myopia by a number of children "is a sacrifice which we must make to education, and of necessity must make it, just as we are both compelled and willing to give our life, if required, for the honor and success of our father-land." How can school and army be compared? We do not send the children to school for the defense of our fatherland, but for their education, in which they ought to remain just as healthy as when they went to school.

Farther, von Hippel took up the assertion already made by Javal, "that perhaps a larger per cent. of short-sighted pupils are found in the higher classes because more normal-sighted children may have left school in the middle classes." Any reasonable general cause why only the normal-sighted should depart and the myopic study farther is, of course hard to find. Von Hippel reckoned that, while up to the lower third class the proportion of those going and those remaining was approximately the same; in the higher third class 6 per cent. of

short-sighted pupils departed as against 24 per cent. of myopic pupils, on the average. I went over the calculations and found that only 4 pupils, on the average, left the higher third class. On such figures, no one could seriously build any conclusions.

Moreover, Schmidt-Rimpler recently brought positive proof that perceptibly more short-sighted leave the higher classes than the lower. Among 809 who had left short-sighted were found: from sixth, 12 per cent.; fifth, 26 per cent.; fourth, 17 per cent.; lower third, 33 per cent., higher third, 38 per cent.; lower second, 43 per cent., and higher second, 45 per cent. Besides, it is a gross error to believe that all who leave take up another life calling. In Frankfurt am Main, of 186 who left the gymnasium, 145 went to other schools.

It is to be seen from the above how wrong is the view of those who consider short-sight an unimportant disease. Of course, the introduction of the Darwinian theory that myopia is for people an adaptation to surroundings, to close work and not a disease—one which the great Darwin would not have understood and a very false use of the theory—and the efforts of Stilling, Tschering and von Hippel, to prove myopia an unimportant, harmless anomaly, were very agreeable to the pedagogues, especially to Wingerath and the authorities who are unfriendly to modern hygienic regulations.

The view of other well-known investigators stand diametrically opposed to those of Tscherning, Stilling and von Hippel.

At their head stands Horner, who was himself short-sighted. This makes his testimony of greater weight. Some speak of myopia as *an appropriate adaptation to the act of work*, like the skin of the finger of a violin player, which grows thick. If we wish to continue the idea of adaptation to an end sought with the idea of adjustment to circumstances, this conception of myopia is entirely untrue. In growing years the majority of eyes have no necessity of becoming short-sighted since power of accommodation is fully sufficient for work; and after youth is past short-sight offers more danger than advant-

age. If we wish, considering adjustment alone, to say: "The change is the necessary product of use, of its extent and of its kind, then this is correct. Then let no one forget that adjustment very frequently passes the bounds of health, whether we consider the flat foot of the mountaineer, the emphysema of the trumpeter, the arched back of the professional gymnast, or the short-sight of the student; it is when undue requisition upon the function of the organ is made, and when the function does not observe the right mean between rest and work."

In direct contradiction of the views of Stilling, Horner considers myopia a great hindrance to choice of occupation, and to advancement in life. In many callings of life, especially in the case of the female sex, the wearing of spectacles is impossible, as such powerful glasses are required that they will not wear them at all. "He who has experienced the chagrin of not being able to pursue a cherished calling, of not being able to choose the business calling on account of short-sight, has a right to emphasize this economical side of the matter."

Horner's experiences with the danger of short sight are very correct, and are deserving of the widest dissemination. "The degree of myopia which indicates the bound beyond which danger is almost the rule, is shown by M6 (not 9, as Tscherning believes). Since this degree of myopia is easily reached by those who at twelve years of age have only one-half, a higher grade of myopia is the more dangerous the younger the person is who develops it. Also now a fact cannot be given too great prominence. *"The danger of loss of the very short-sighted eye increases with age, and becomes, on the average, from the age of 50 or over, more threatening.* Of 1,878 short-sighted people whom Horner examined in his practice from 1880 to 1883, 34 per cent. developed dangerous complications; 9 per cent. diseases of vitreous humor; 11 per cent. inflammations of the choroid; 4 per cent. detachment of the retina, and 23 per cent. cataract. The average age of these 629 cases of complicated myopia was 50.3 years.

As is known, special schools have been proposed for the

short-sighted; Horner considers them unnecessary. We rather agree entirely with his words: "It would be better to treat all children as if they might become short-sighted."

Horner comes to the commendable conclusion that the war against myopia and its spread is one warranted by the need of those who are becoming short-sighted, for those who are so, and for those who come after. "Fortunately the battle has broken out all along the line; we should take advantage of it before it flags".

Also Schmidt-Rimpler comes to similar conclusions and holds that the view that the danger from myopia begins with M 9, does not agree with clinical experience. He correctly emphasizes the fact that in spite of correcting glasses, myopia of middle and higher degrees causes loss of keenness of vision for distance.—The following determinations of keenness of vision in the case of 3420 eyes of school-children prove this:

	$\% S > 1 =$	$\% S > 1/2 =$	$\% S < 1/2 =$
E - - -	89	9	2
M 1—3 - - -	60	35	5
M 3—6 - - -	41	50	9
M > 6 - - -	16	65	19
H < 3 - - -	45	31	24
H > 3 - - -	12	38	50
Astigmatism - -	1	52	47

Scherdin found in the Real-Schule in Stockholm, as Key reports, normal keenness of vision in the case of only 70% of short-sighted pupils.

Leininberg in Wurzburg examined 2893 myopic eyes for keenness of vision. This was found to be about = 1 with $M < 2D$; $S = 0.9$ with M 2—4; $S = 0.8$ with M 4—6; $S = 0.6$ with M 6—10; $S = 0.5$ with M 10—12; $S = 0.3$ with M 12—18; $S = 0.2$ with M > 18.

Priestley-Smith argues against the view that short-sight is a development of the human eye. He says, "If myopia is an accompaniment of intellectual progress, it is an accompany-

ing evil. If nature had in fact the development of the eye in view, then she ought to change the action of the accommodation muscle and make possible an active accommodation for distance, that the short-sighted person might acquire the ability to see in the distance.

Also Schiess-Gemuseus and Seggel argue warmly against Tscherning's view that myopia induced by reading is to be considered unimportant. Seggel proves the really injurious influence of myopia by the following tables of 1619 myopic eyes examined by him, of which he determined the keenness of vision.

EYES				MYOPIA				AVERAGE KEENNESS OF VISION
186	-	-	-	0.25	-	-	-	1.1
74	-	-	-	0.50—0.75	-	-	-	0.92
267	-	-	-	1.00—1.75	-	-	-	0.80
239	-	-	-	2.00—2.75	-	-	-	0.77
186	-	-	-	3.00—3.75	-	-	-	0.75
200	-	-	-	4.00—4.75	-	-	-	0.73
173	-	-	-	5.00—5.75	-	-	-	0.65
103	-	-	-	6.00—6.75	-	-	-	0.59
85	-	-	-	7.00—8.00	-	-	-	0.55
68	-	-	-	8.00—10.00	-	-	-	0.53
26	-	-	-	10.00—13.00	-	-	-	0.40
12	-	-	-	14.00—20.00	-	-	-	0.13

Seggel very correctly adds in conclusion: "*Since myopia even in its lowest degree of 0.5 D is accompanied by $S < t$ and since keenness of vision decreases in proportion to increase of myopia, therefore the combating of myopia, not only on its own account but also on account of the necessarily accompanying decrease of keenness of vision, is a pressing duty not often enough urged.*"

Nagel expresses himself not less energetically. He is a learned investigator and a keen critic. Stilling had proclaimed that myopia caused by work "is not to be taken so tragically", as chanced to be done by several oculists. He says that

higher myopia offers advantages and moderate degrees are harmless, that serviceability of the many is not injured by the increase of myopia, that it is time an end was put to the disturbance made at the expense of the school authorities, that the oculists should have a care not to thrust themselves into the domain of instruction and matters of this kind. Nagel considers all these objections unfounded. "The injury of continued close-work," says he, in spite of all Stilling says with exaggeration of the harmlessness of myopia, remains proved for every unprejudiced observer, and, apart from the connection of cause and the associated theories it is warranted and imperative to combat most earnestly the injury wrought by too early and too severe close work. What has in this matter been gained with much exertion, we should not lightly ridicule and reject."

In similar manner Pflüger attacked the underrating by Stilling of the harmfulness of close-work, and asserted that his unfounded conclusions since they imperilled the progress already made in school-hygiene, must work harm among the laity, especially in the educational world.

We declare ourselves of this opinion after twenty-five years of investigation and we affirm that, in spite of the objections of the above works setting forth the importance of myopia, we are unable to find one author who is not of the opinion that *in the Schools everything should so be arranged that it will not cause injury to the eyes.*



